

The IMPACT of Discovery STEAM Experience

Juno & Europa: Engineering and Science Perspectives



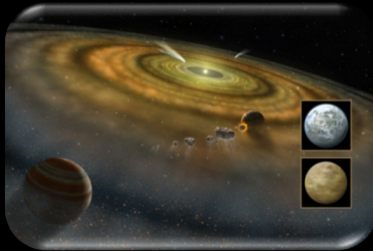
Jet Propulsion Laboratory
California Institute of Technology

Tracy Drain and Bob Pappalardo

April 9, 2016



Tracy Drain's Path to NASA



BS in Mechanical
Engineering 1998

NASA Langley Research Center



MS in Mechanical
Engineering 2000



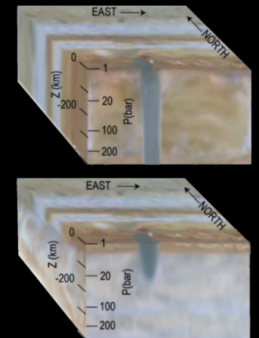
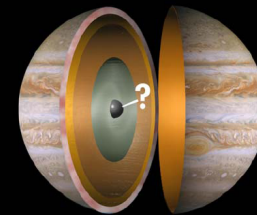
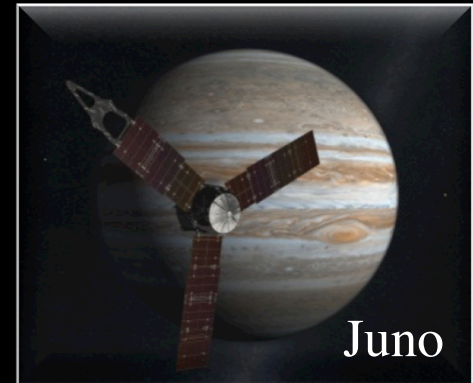
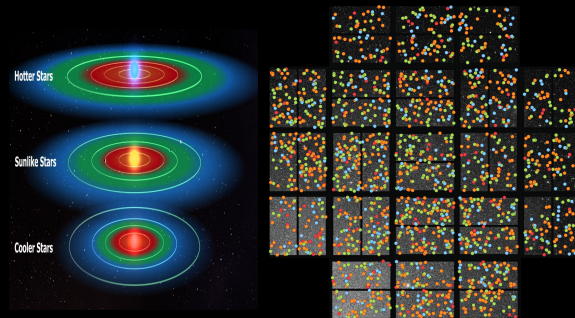
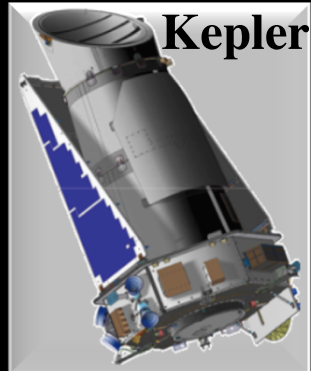
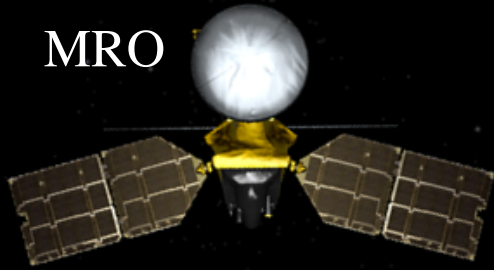
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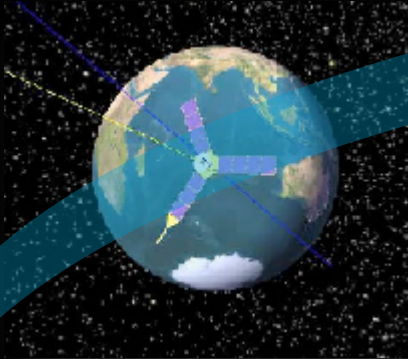
Tracy Drain: Flight Systems Engineer @ JPL since 2000

MRO

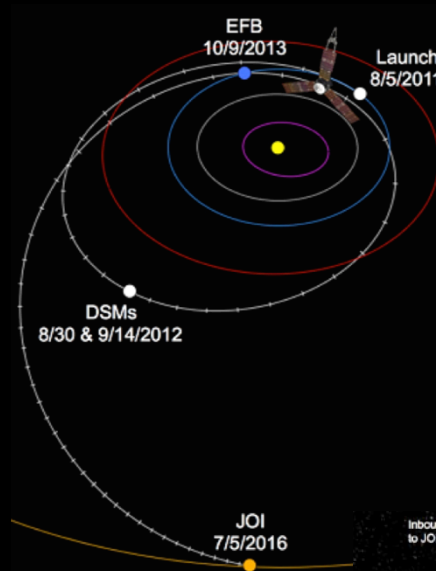


Juno Mission Overview

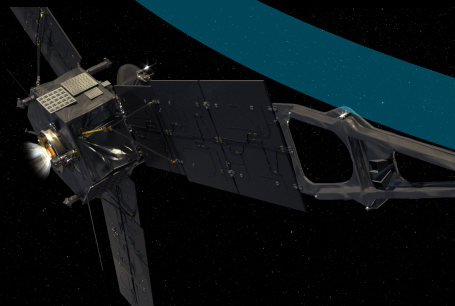
Earth Fly-By Oct 2013



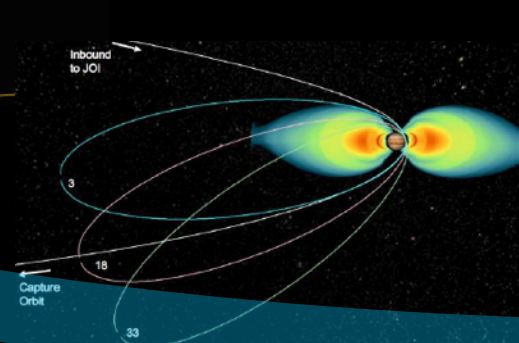
**Deep Space Maneuvers
Aug/Sept 2012**



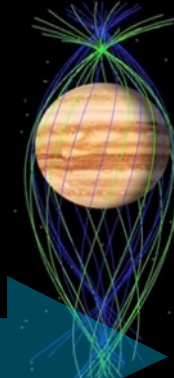
Launch Aug 2011



**Jupiter Orbit Insertion
July 2016**

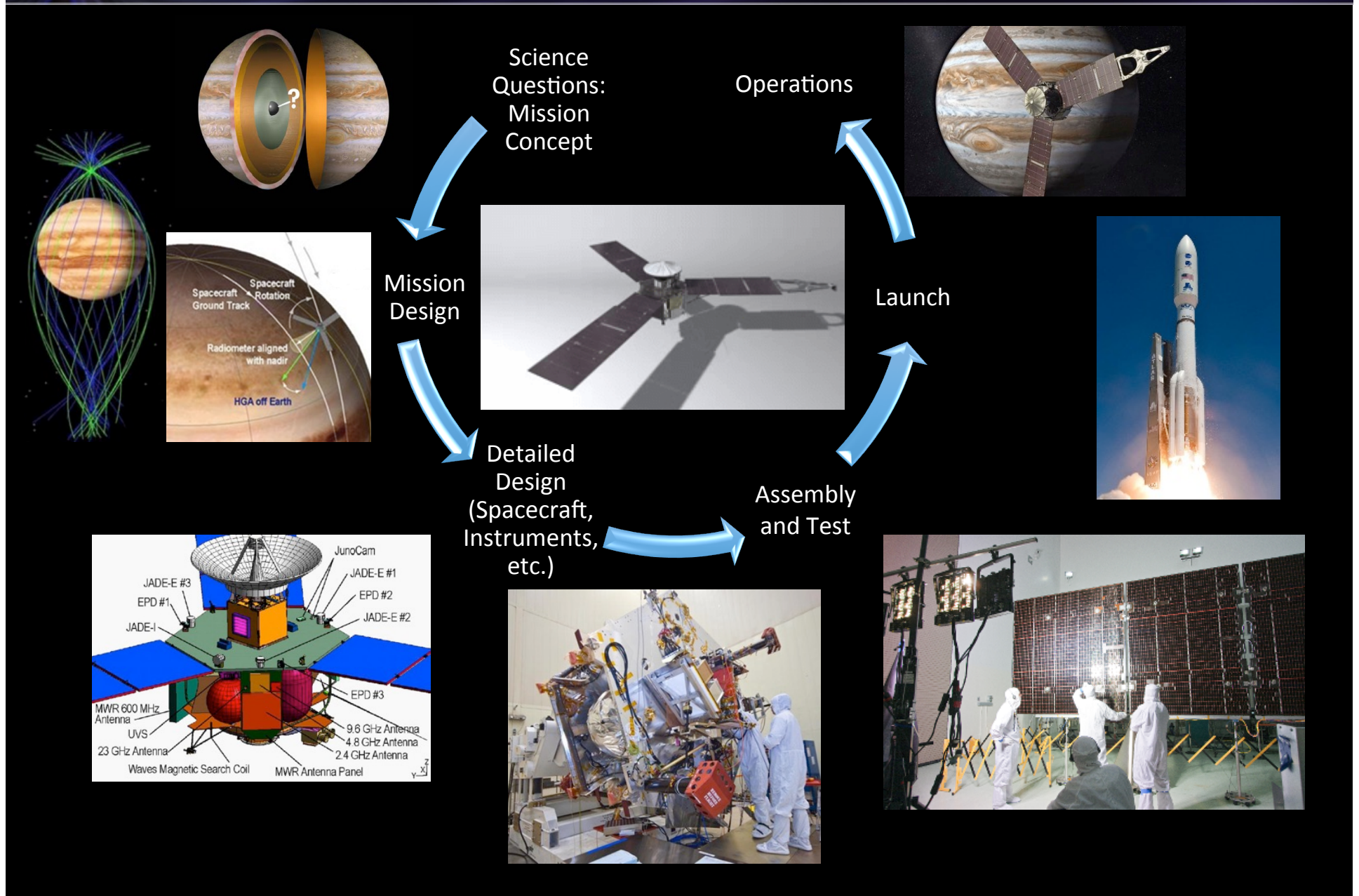


**Science Orbits
Oct 2016 to Feb 2018**



**Deorbit
(into
Jupiter)**

Flight Project Design Cycle



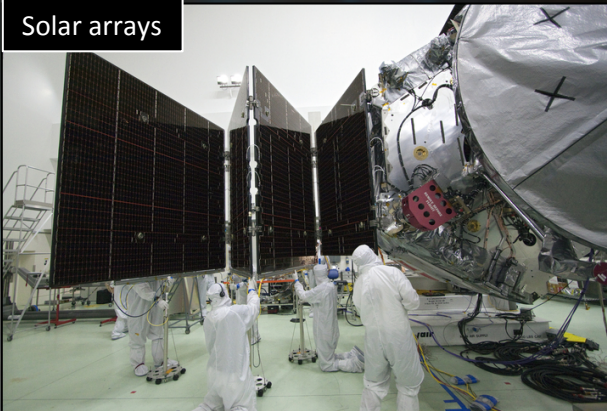


The Juno Spacecraft: Details

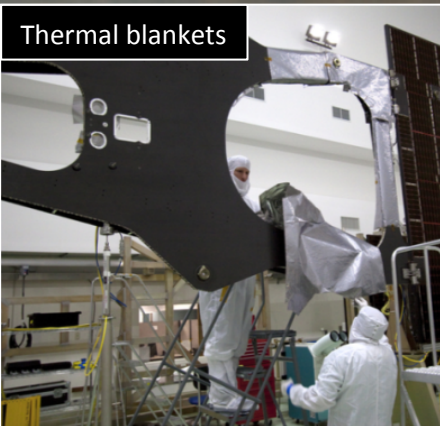
Radiation Vault



Solar arrays



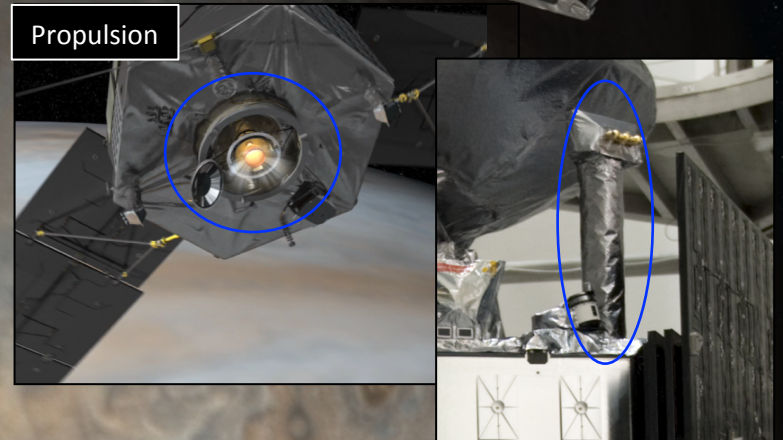
Thermal blankets



Telecom

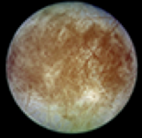


Propulsion

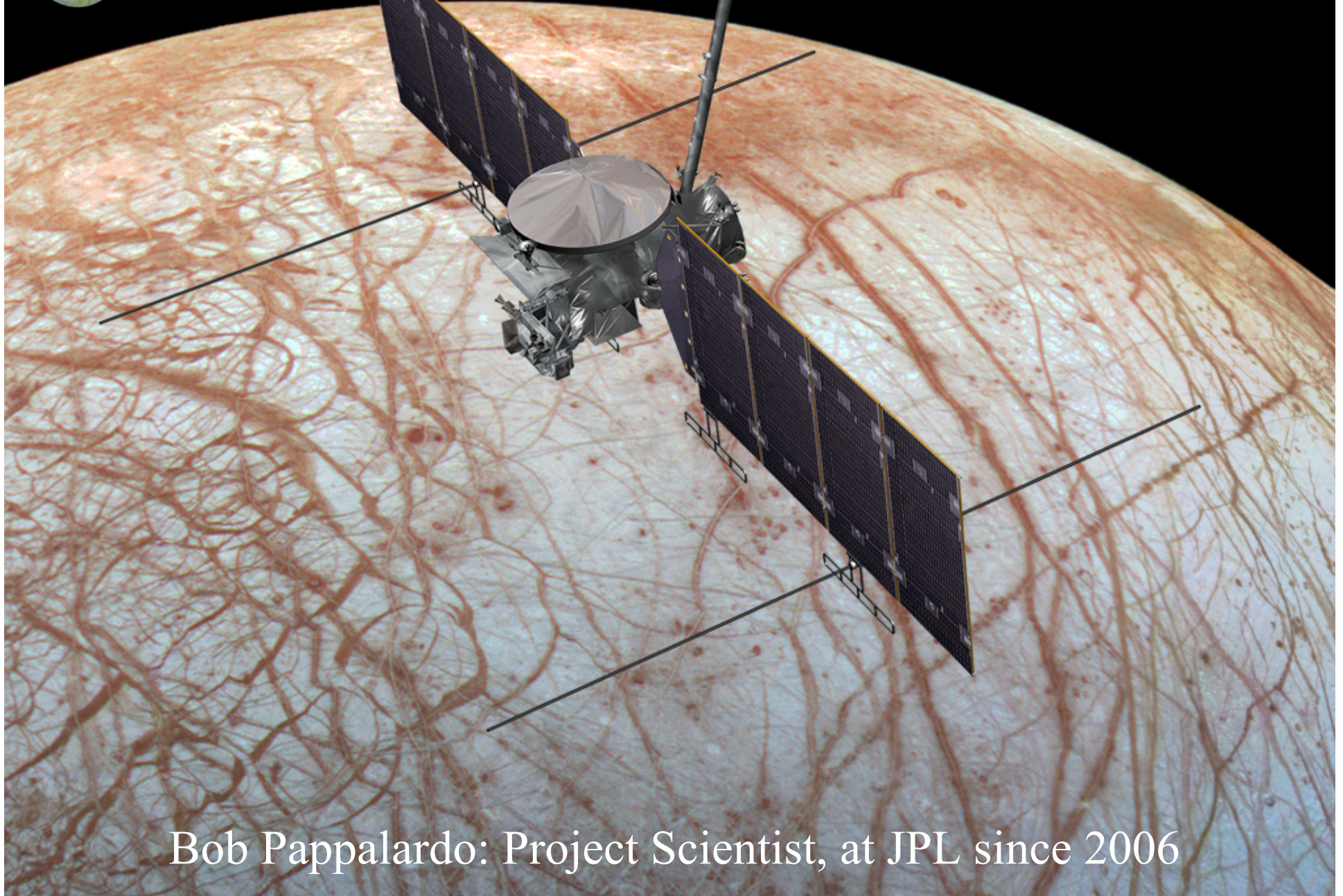


Some Key Engineering Challenges the Juno Design Had to Meet:

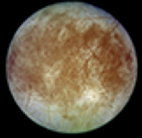
- High Radiation at Jupiter
- Long Juno/Sun-Range
- Long Juno/Earth-Range
- Need to Get Into Orbit



NASA's Mission to Europa

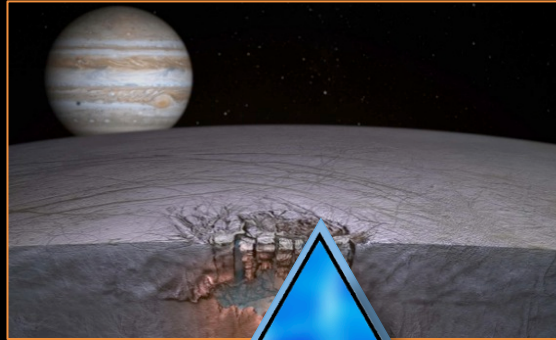


Bob Pappalardo: Project Scientist, at JPL since 2006

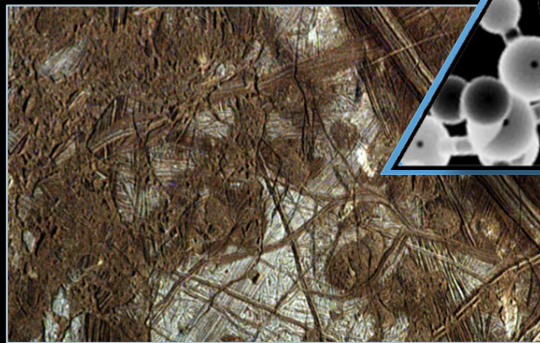


Europa: Ingredients for Life?

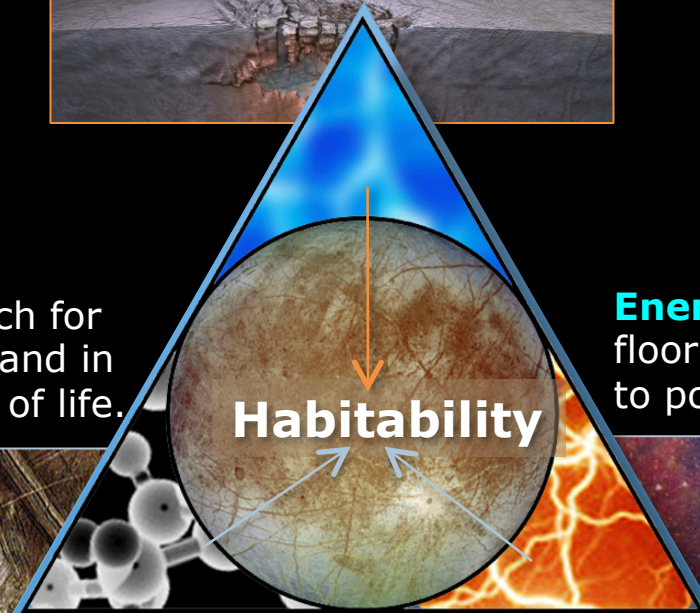
Water: A global ocean and lakes could be hidden by Europa's icy shell.

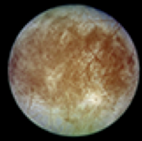


Chemistry: We can search for evidence, on the surface and in plumes, for the elements of life.



Energy: Surface and ocean floor chemicals could combine to power life.





Europa Mission Goal & Key Questions

- **Goal: Explore Europa to investigate its habitability**

- **Objectives:**

- **Ice Shell & Ocean:**

- Is there subsurface water, and where?

- What are the characteristics of the ice shell?

- How salty and thick is the ocean?

- Is there exchange between the ocean and surface?

- **Composition:**

- What does the composition of Europa tell

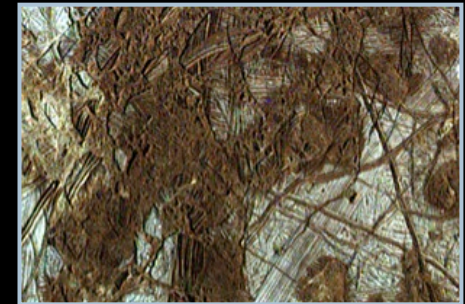
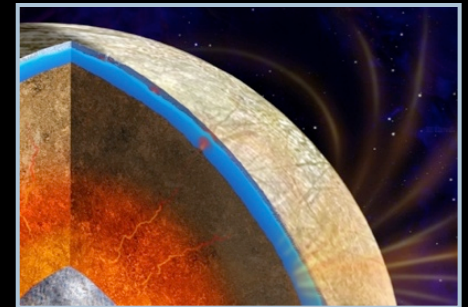
- us about the habitability of its ocean?

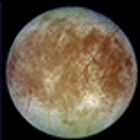
- **Geology:**

- How do its surface features form?

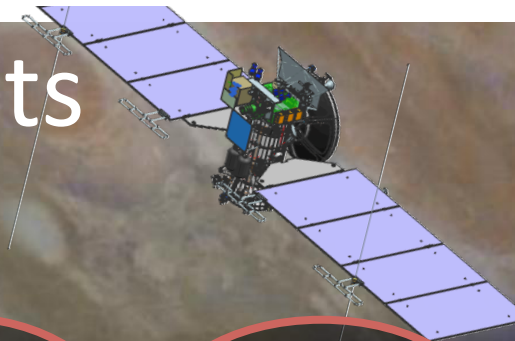
- Are there sites of recent or current activity?

- What is the surface like at small scales?





Europa Mission Instruments



MASPEX

*Mass Spectrometer
sniffing the
atmosphere*

SUDA

*Dust Analyzer
surface & plume
composition*

ICEMAG

*Magnetometer
sensing ocean
properties*

PIMS

*Faraday Cups
plasma environment*

Europa-UVS

*UV Spectrograph
surface & plume/atmosphere
composition*

EIS

*Narrow-Angle Camera +
Wide-Angle Camera
alien landscape in 3D
& color*

MISE

*IR Spectrometer
surface chemical
fingerprints*

E-THEMIS

*Thermal Imager
searching for hot spots*

REASON

*Ice-Penetrating Radar
plumbing the ice shell*

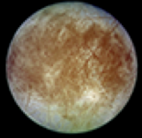
*Gravity Science
confirming an
ocean*



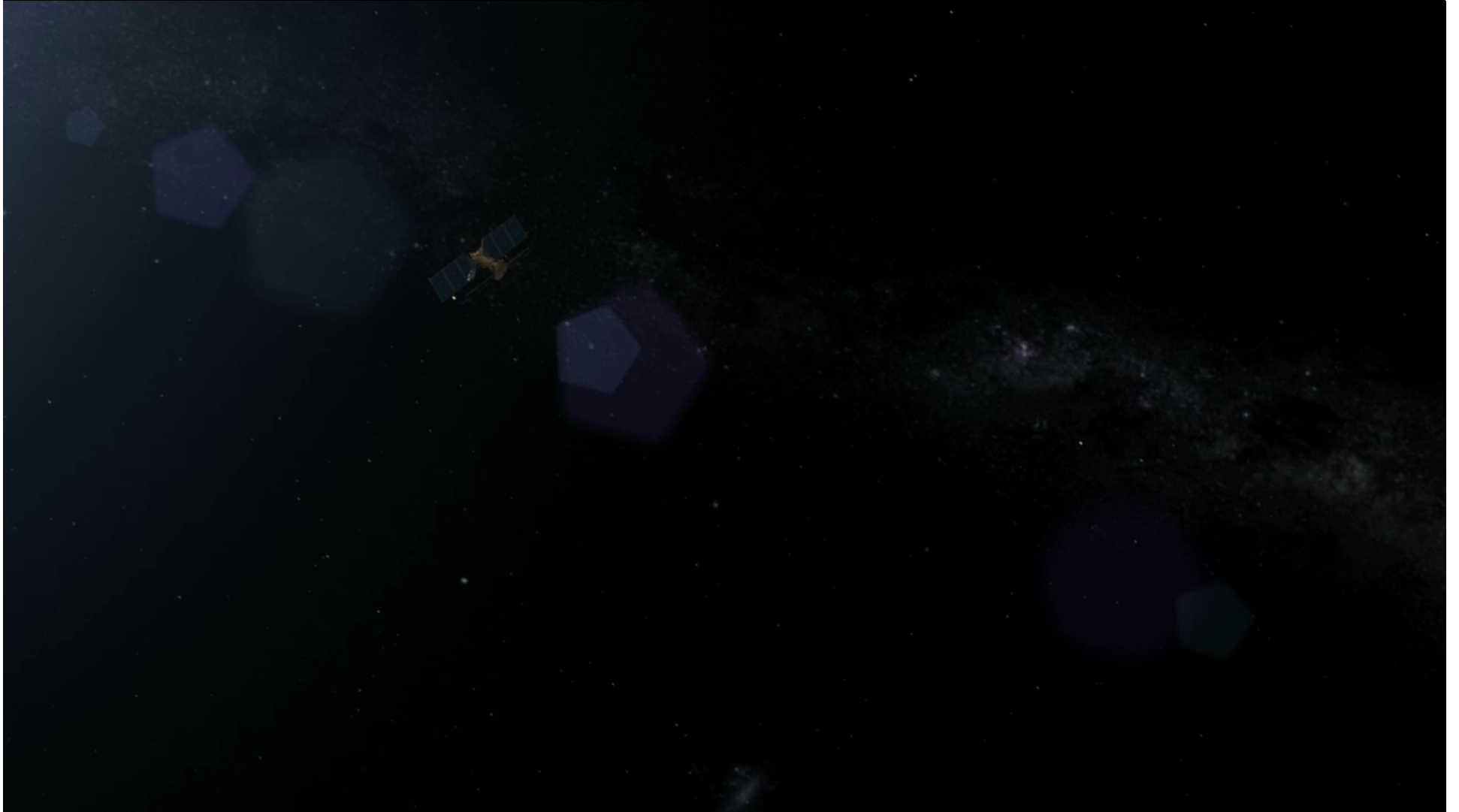
Remote Sensing



In Situ




Europa Mission Concept



Scientists and Engineers at NASA

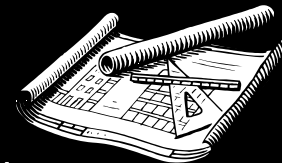
- **Scientists** determine:

- What **questions** to ask/pursue (e.g. how do planets form?) 
- **Where** to look for the answer (e.g. at Jupiter? at nebulae?)
- **How** to look (what kind of data is needed? what kind of instrument?)
- Exactly **when/where** to take the observations/measurements
- How to **interpret** the data, once we get it back to Earth



- **Engineers:**

- Generate detailed **designs** for **instruments**
- **Design** the spacecraft to support the instruments
- **Design** the computer systems on the ground to receive/process data
- Develop the **mission plan** (trajectory, timeline etc.)
- **Operate** the spacecraft once it gets to its destination



There is a LOT of overlap and collaboration between the two...
Engineers and Scientists work together in space exploration!